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ABSTRACT

This paper describes the courses and teaching strategies used for interactive television transmissions emanating from the University of Lowell (Massachusetts) and received by secondary and elementary schools. Five teaching strategies were employed: demonstration, activity-based instruction, team-teaching, discussion, and lecture. The modifications necessary to adapt each strategy for use with the medium are reported. Observation of interactive television lessons has revealed the need for thorough pre-planning on behalf of the instructor and careful consideration of the means by which the medium may enhance the attainment of goals. It is hypothesized that teachers who teach via interactive television will show greater variety in the strategies they employ and increased effectiveness as measured by changes in student learning outcomes and attitudes. (16 references) (Author/EW)

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MULTIPLE TEACHING STRATEGIES FOR USE WITH AN INSTRUCTIONAL TELECOMMUNICATIONS NETWORK

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ABSTRACT

This paper describes the courses and teaching strategies used for interactive television transmissions emanating from the University of Lowell and received by secondary and elementary schools. Five teaching strategies were employed: demonstration, activity-based instruction, team-teaching, discussion and lecture. The modifications necessary to adapt each strategy for use with the medium are reported. Observation of interactive television lessons has revealed the need for thorough pre-planning on behalf of the instructor and careful consideration of the means by which the medium may enhance the attainment of goals. It is hypothesized that teachers who teach via interactive television will show greater variety in the strategies they employ and increased effectiveness as measured by changes in student learning outcomes and attitudes.

INTRODUCTION

The Advent of Interactive Television Networks

Instruction through the medium of television has had a place in the school curriculum since the 1950's, yet evidence of its effectiveness is sparse. Early research reported favorable attitudes of students and teachers to instructional television, indicating that it can act as an effective motivator especially at lower grade levels.(1) Yet the nature of one-way television communication dictates passive learning by students and has caused television in schools to be seen as a tool for enrichment rather than for direct instruction.

The interactive capability of television and other technologies holds promise for a reversal of this trend and since the 1970's the feasibility of their use in educational settings has been explored. Additional impetus is provided by the declines in student enrollment experienced by high schools, scarcity of resources in rural areas, and teacher shortages in critical subject domains, making certain courses non-viable.(2) Thus the early part of this decade has seen the establishment of interactive telecommunications networks primarily designed to link high schools for the sharing of instruction. School systems

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in areas of Illinois, Minnesota and Wisconsin were among the first to develop school-based interactive television networks*.[3] Recently two regions in Texas have established interactive television (IATV) systems offering language and other advanced courses, while New York is using IATV on a trial basis.[4]

Instructional Strategies for Interactive Television

Very little has been written about the use of interactive television in schools. The literature which is available attests to the fact that lessons using this form of two-way communication are generally conducted in a lecture format between small groups of students and one teacher. In Carroll County, Illinois, the Carroll Instructional Television Consortium connects four high schools and transmits advanced level courses among them.[5] Each of the four schools has a studio in which all interactive lessons are conducted. There are four monitors in the studio on which participants may watch the teacher and students at the other sites. The teacher is equipped with a special effects generator and three color cameras. It is this configuration of equipment which is rapidly becoming the model for others to emulate, for it allows the teacher to be in full control of the camera shots and thus requires no extra personnel. It also lends itself to the instructional form which is most closely allied to that used in traditional classroom settings. Hagon [6] reports that teachers do not need to change teaching strategies for lessons conducted via two-way television

> The first teachers using two-way television did so with few teaching models. Fortunately, we discovered early on that the setup was much more like a conventional classroom than any of us expected.

Carey [7] has questioned the appropriateness of the exclusive use of traditional classroom models with interactive television. He argues that the medium cannot replicate borrowed formats effectively, however it does provide a means of developing new strategies and opportunities not available to face to face communicat'on and one-way television. Restricting the use of interactive television to students enrolled in advanced courses also appears to limit the potential benefits of the medium, yet educators seem to be reticent about its use with lower- ability students. A study of dropouts from interactive television courses in Minnesota concluded that the system is not well suited for students experiencing academic difficulty or for those who were not self reliant learners.[8] However, as very little reported evidence exists for the use of interactive television with anything other than advanced students, its efficacy with less-- able learners has not yet been tested. Recently Ritter [9] has described the use of two-way cable television in Irvine, California, to conduct a mathematics enrichment course with sixth

grade students, to connect non-English-speaking students throughout the district with an English language instructor, and to instigate a cross-age tutoring program in mathematics and science. These examples show some of the creative potential of interactive television when school districts are prepared to use it with a wide range of students for a variety of educational opportunities.

If evidence of the use of interactive television is scarce, data concerning its effectiveness is even rarer. Evaluation of the Illinois network suggests that students taught by interactive television learn as well or better than their peers in ordinary classes of the same level and that teachers improve in effectiveness as they continue to use the medium.(10) However, at Texas A & M University where two groups of medical students received instruction via interactive television and by in-person presentations, it was found that the delivery system did not influence student achievement.(11) Whether this result will be replicated by evaluators of high school networks which serve fewer students of younger age, remains to be seen.

It is thus apparent that there is a need to extend the work done with interactive television in order to ascertain its potential use with a variety of students and subjects. The focus of this paper will be to describe the teaching strategies which have been used with the University of Lowell's Instructional Telecommunications Network (ULITN), and the way in which each was modified for or enhanced by the medium. Finally we shall discuss the implications of our findings for future instruction via interactive television.

THE UNIVERSITY OF LOWELL'S TELECOMMUNICATIONS NETWORK

The Role of the Center for Field Services and Studies

The University of Lowell's Instructional Telecommunications Network (ULITN), housed at the Center for Field Services and Studies (CFSS), evolved in response to a need expressed by local school superintendents for a link between public schools and the University's varied resources. Since 1984 the CFSS has facilitated negotiations with local cable companies and has aided the school systems as they planned the configuration of the network. Fulfilling this administrative role is subsidiary to the mission of the CFSS which seeks to improve the quality of instruction occurring in classrooms throughout the region. With respect to the Instructional Telecommunications Network this mission is achieved through:

the demonstration of instructional strategies appropriate for and unique to the use of interactive television

the delivery of interactive inservice courses and other forms of professional collaboration, in order to reach educators at distant sites
the provision of unique instructional opportunities for students using the various facilities and faculty of the University.

The ULITN is not designed to compete with commercially produced instructional television programming, neither has it been instituted to usurp the role of the classroom teacher. We differ from school-based networks in that transmissions from the University tend to offer courses which complement the curriculum of students of all age groups. Such courses are conducted by University faculty, consultants or students and not by one of the classroom teachers involved in the link. In this way the teachers are afforded the opportunity to observe their students interacting with others. It is hoped that this partnership between schools and university can produce effective instruction and enhanced opportunities for students. A further goal is to use interactive television to alleviate some of the educational inequities which exist between the various schools linked by the network. ULITN enables students from communities of disparate socioeconomic and racial profiles to receive the same form and diversity of instruction. Such interactions will, it is hoped, encourage understanding of ideas and views held by various ethnic groups where before no channel for dialogue existed.(12)

The Equipment

The equipment configuration for the ULITN is similar to the model used in Illinois, employing three color cameras, a special effects generator and two monitors. The special effects generator allows the teacher to switch between the three cameras in order to choose the image to be transmitted to the remote site. It also provides the ability to split the image in a variety of ways to encompass the view from two cameras at the same time. An additional piece of equipment used is a ceiling mounted projection television which produces a ten feet high image of the students at the distant site on the back wall of the classroom. This and the over-head camera are the only fixed pieces of equipment in the room and thus there is flexibility open to the instructor concerning placement of cameras and monitors. The image shown on the monitors in the classroom may also be varied to either show the students at the distant site, or more commonly to show the image being transmitted. Of the three cameras, one is focused on the instructor, another on the class, while the third is fixed above the head of the instructor who can use the remote zoom to focus on writing, demonstration materials etc. The camera positions are chosen by the instructor prior to the lesson (contingent upon the type of teaching strategy to be employed), he/she then controls the shots to be transmitted throughout the

lesson. When class sizes increase, a technician is used to change the position of the class camera in order to bring students into view as they address the instructor or other students. All transmissions can be video-taped through the use of a built-in recording system. Video and audio tapes may also be played during the lesson and viewed at both sites simultaneously.

TABLE 1
Courses Transmitted via ULITN during 1986/87

Course/ Lesson	Level	number of students at each site: sending	receiving
1.Computer (t) Architecture	College Freshmen	12	13
2.Science (t)	Grade 6	25	24
3.Word Processing	Junior/High School	8	7
4.Science	Grade 5	21	22
5.Thinking Skills	Teacher Inservice	12	12
6.Differential Equations	College/High School	22	3
7.Aquatic Studies	Grade 4	24	25
8.Nuclear Reactor	Grade 11		
Demo.			024
9.College Survival	College/High School	20	20

(t) internal trial of the ULITN

Courses Transmitted via the ULITN

Having the flexibility to rearrange the equipment in the classroom at the transmission site allowed us to use the network for a variety of courses and utilizing different teaching strategies. The first transmissions were made internally, connecting students on two of the University's three campuses for instruction. A trial was also made with 50 elementary students (grade 6) who were brought to two different sites at the

university for a science lesson. These trials were followed by a summer course which was again transmitted between two university sites. All lessons since have been transmitted from the University and received by schools (as detailed in table 1.). Because the school system of Lowell is not as yet connected to the network their students have been brought to the University in order to share in the interactive lessons with students of other school districts.

TEACHING STRATEGIES EMPLOYED AND THEIR MODIFICATION FOR USE WITH INTERACTIVE TELEVISION

It is our firm belief that any technology should be used as a tool to enhance instruction and not as an end unto itself. Thus the goals of the lessons transmitted via interactive television should not be constrained by the equipment, yet the capabilities of the latter must be considered in the lesson design. Still in the early stages of transmission, we are faced with the need to experiment with the network, but we do so in order to base future lesson planning decisions upon our findings. Our work has thus involved us in using a variety of teaching strategies with interactive television, which we have carefully observed and scrutinized in order to determine the most effective means of teaching each via the medium. The strategies which have been used are:

demonstration
activity-based instruction
team teaching
discussion
lecture

We hoped to show that interactive television does not limit the repertoire of strategies available to teachers, but provides new possibilities for those who wish to enrich their teaching. Perhaps we were naive in believing that lesson preparation would not be dramatically increased, for we were soon to find that teaching via interactive television requires the dedication to succeed, but in the hands of a good teacher it can make a startling impact.

Each of the strategies used with the University of Lowell's Instructional Telecommunications Network may be seen in traditional classrooms, but as reported earlier lecture formats are most commonly practiced. If we are to impact instruction, it is essential that we expose teachers to different ways of approaching a concept. The ULITN allows us to reach a wider audience and enables teachers to observe the effects of the strategy being used with their own students.

<u>Demonstration</u>

The use of demonstrations enhances lessons which are teacher dominated and give students something visual on which to focus their attention. The over-head camera is one of the features of our interactive television system which was found to bestow a new dimension on the use of this particular strategy. The camera is used to zoom in on objects placed in front of the teacher. In science lessons the teacher is now able to aid all students in the dissection of a laboratory organism, focusing the camera on specific organs as he/she describes the dissection technique required. Demonstrated experiments may be performed in front of large numbers of students with the absolute confidence that each has a perfect view of the reactions occurring (a feature which is not available in a normal science laboratory where the view is often obstructed). Constructing graphs, drawing student attention to the details of photographs or objects, and writing equations or new terms, may all be done with greater clarity than through the use of a chalk-board or over-head projector. Throughout, the teacher is facing his/her classes and is able to see student problems as they arise.

A further type of demonstration, involves the transmission of activities not usually available to high schools, or which are potentially dangerous. In the past such demonstrations have been recorded on video tape and watched by students. However, interactive television can be used to expose students to the situation without losing the ability to communicate with their instructor. In one particular example, a lesson was transmitted from inside of the University of Lowell's nuclear reactor at the request of a high school's science faculty. Students were given a 'remote' tour of the reactor before monitoring a reaction in progress and recording the readings. Throughout, the students were able to communicate with the instructor inside the reactor. Follow-up lessons were conducted by the high- school faculty utilizing the data obtained during the transmission.

Activity-based instruction

Demonstration is not the only means by which students may be introduced to a concept or be provided with new information and indeed demonstration does not allow active involvement with materials. A major thrust of the work of the Center for Field Services and Studies is to improve the quality of science education, especially at the elementary level. We are committed to a program of inservice work which encourages teachers to use activity-based science in their classrooms. For this reason, we were determined to show that activity-based work could be accomplished using interactive television. Once again the over--head camera was required, but this time to prepare students to participate in small group activities. The equipment needed and procedures to be followed were first shown and described before

the students began their work. The teacher was able to see the students at both sites as they worked on the activity and could answer questions as they arose. However, it soon became obvious that modifications to normal classroom activity-based work had to be made.

We found that students at the remote site were reticent to speak to the instructor unless they were asked a direct question, thus making normal observation and guidance of student work difficult. Similarly, conversations between a group of students at the remote site and the instructor were not possible, neither could the instructor see if students were engaged in a potentially hazardous situation. For these reasons activity-based strategies have been found to require the presence of a responsible adult at the remote site. This in itself however, creates new avenues for teachers as it opens the possibility for team-teaching.

Team Teaching

An unintended consequence of the use of activity-based instruction with interactive television has been the evolution of team-teaching situations. From early beginnings of using teachers to assist their students during activities we have begun to involve teachers in collaborative planning sessions. Such collaboration has been heralded as necessary and desirable if we are to diminish the isolation of classroom teachers and encourage professional exchange of ideas. (13) To date the instructor at the transmission site has always acted as the lead teacher, introducing new concepts and directing activities. The teacher at the remote site has assisted students and mediated question and answer sessions. All team-teaching situations have been conducted with full-sized classes of elementary students. Planning has been done during face-to-face meetings between teachers and instructor.

Discussion

Perhaps the most difficult strategy to model successfully using interactive television is a lesson requiring discussion between students. We have become acutely aware of the lack of student-to-student interaction which occurs in traditional classrooms, most talk being mediated through the teacher. This communication deficit is magnified by the use of interactive television. We have found that students of all ages are reticent to speak to each other over the system once the lesson has begun. From the few occasions when discussion has been the chosen instructional strategy we have learned that success depends on students at both sites knowing the instructor and each other. Open discussion is difficult enough to achieve within a single classroom, via interactive television it requires students to feel comfortable with the medium as well as with each other.

Lecture

Lecture-based strategies are of course easily accomplished through the use of interactive television and require least modification to existing practices. The lecture can even be enhanced if the instructor is prepared to use the special effects generator to vary the image being transmitted. One of the two instructors using lecture, continued to utilize the chalk board to record class notes and thus required a camera operator to focus on the board as he wrote. The other instructor used the over-head camera for note writing, but as he had already prepared visual aids for an over-head projector a camera operator was required to focus on these. Neither chalk-board nor over-head projector proved to be as effective as the use of the over-head camera. The only modification in teaching made by either instructor was that they ensured that students at the distant site were included in question and answer sessions.

PREPARING FOR INSTRUCTION VIA INTERACTIVE TELEVISION

In the preceding section we have described the various teaching strategies and courses transmitted via the University of Lowell's Instructional Telecommunications Network. The translation of each strategy to interactive television classes requires them to be modified to greater or lesser degrees, thus pre-planning of televised lessons is essential. Coming to a transmission with a vague idea of what is to be taught spells disaster; pauses and indecisiveness seem to be accentuated by the system.

Pre-planning

In preparing instructors to work with interactive television we have found it essential to begin by requiring a full and detailed lesson plan in which the goals and the strategies most applicable to attaining those goals are described. It is also necessary in the early stages of planning for the instructor to visit the classes that will receive the transmission. Students then have the chance to ask questions about the forthcoming lessons and are able to meet the instructor. The instructor then liaises with the Manager of Media and Telecommunications (who also has a teaching background) and together they decide whether the chosen strategy will be appropriate for interactive television. It has to be recognized, especially with activity-based strategies, that there are certain activities which are organizationally impossible to achieve, but the goals of the lesson may be equally well served by choosing an alternative teaching technique such as demonstration.

Once lesson plans and strategies are decided, instructors are

asked to prepare a story-board for their lesson, detailing the cameras to be used at each transition point, any special effects to be generated (e.g. instructors head in one corner of the screen and an object to be described filling the remainder). Experience allows instructors to relax their production of story-boards as they become familiar with the system and know how to achieve the desired effects. What cannot be relaxed is the pre-production and testing of all visual materials to be used. Clarity of diagrams and writing placed beneath the over-head camera is obviously essential. We have found that visual aids prepared with felt-tip pens or printed, on light colored paper of the correct aspect ratio ** are clearly seen on the students' monitor. Notewriting as the lesson proceeds can be done, but the technique needs practice to keep the instructor's hand from obscuring the students' field of view. What is unsuccessful and indeed obsolete is the use of chalk-board and over-head projector. Instructors who continued to use these aids did so because they did not have the time to prepare new materials for use with the system.

A pre-planning feature unique to activity-based strategies is the need to ensure that the equipment required at each site is organized and/or delivered in such a way that the students have ease of access. If the instructor merely requires that worksheets or tests be available at remote sites, he/she may send these via facsimile machines.

Classroom Organization

The University of Lowell's Instructional Telecommunications Network differs from those operating in other regions in terms of the classroom arrangement at the transmitting site. Most other systems employ a fixed studio design. We have also conducted most of our courses with large groups of students. With large classes at each site, the room arrangements are decided in advance in order for the cameras to have all participants within the field of view. Arrangements for discussion strategies are particularly important. Seating at both sites must ensure that all students can see one another and that they do not have to turn to face a camera. Similarly, microphone positioning has proved crucial. In a large group it is often difficult to see when someone is beginning to speak and if the audio is unclear the students feel unable to interject with their opinions for fear of interrupting others.

Consideration of classroom arrangement is also an ingredient contributing to the success of activity- based work. The initial visit to the remote site affords the instructor the opportunity to make modifications which will enhance direction-giving and equipment distribution during the lesson. A further consideration is that activity-based work requires the instructor to move among the students. At these times the camera focused on

the class is used in order for students at the remote site to see their peers. One problem that arose out of this requirement was that instructors tended to speak to the image of the students on the back wall of the classroom when addressing the remote site instead of facing the camera focused on the class. This tendency was overcome with practice and has meant that we do not have to restrict the instructor to a position behind a podium or desk, which elsewhere is commonly the practice. (14)

Training

The new instructor must become familiar with the positioning of equipment and its basic operation (although no technical knowledge is required). Before the lesson, a training session with the equipment is given at which the instructor learns to use the special effects generator to switch between the three cameras and ascertains the correct positioning, with respect to the overhead camera, for visual aids and other equipment. We have found that teachers quickly adapt to the system and can comfortably switch cameras to focus on students or objects as the lesson demands.

Encouraging Interaction

The literature concerning interactive television does not address the form or frequency of verbal interaction which occurs between teachers and students, neither does it refer to student to student interaction. We are left to assume that because of the small class sizes usually involved, it is relatively easy for the teacher to elicit responses from all students and that a certain informality develops between students over a period of time. Our experience has been somewhat different.

Teacher-student interaction is easily achieved if the teacher poses questions and requires students at both sites to raise their hands in order to supply an answer. In this way the teacher can ensure that all students are included in question and answer sessions. We have found that during activity work students at the remote site do not tend to speak with the instructor who must therefore learn to call on students by name periodically to check on their progress. At present students turn to the teacher in their room for assistance and we suspect that this will remain the case as long as they are more familiar with the teacher than the instructor and retain their hesitancy to speak to an image on a television screen This reticence was shown by students of all age groups.

The lack of student to student interaction which occurs in traditional classrooms is replicated in interactive lessons. Unless the teacher encourages such interaction between sites, there is an eerie silence filled only by the teacher's voice as he/she continues to ask questions which do not provoke dialogue.

Positioning of students, monitors and cameras becomes crucial if participants are to overcome their reticence to speak to students at the other site, but this alone will not solve the problem. The discovery of teaching behaviors, techniques and styles which successfully encourage student to student interaction will be an integral part of our future work.

FUTURE WORK
USING INTERACTIVE TELEVISION

This paper has addressed the efforts of the University of Lowell, through the agency of the Center for Field Services and Studies, to impact the instruction occurring in elementary and secondary schools via interactive television. The work here reported represents the first phase of the planned use of the Instructional Telecommunications Network. To date broadcasts have emanated from the University and have been received in two school districts. During the school year 1987/88 it is hoped that microwave and cable connection will allow us to deliver instruction to a further two school systems. Thus the second phase of our work will include aiding the development of inter-system transmissions between this initial cluster of 4 school systems, while continuing to offer learning opportunities from the University.

We have focused thus far on the instructional issues associated with teaching via interactive television, what is now required is an evaluation of student learning via the medium. Clark [15] contends that the medium itself does not directly influence learning, but that attributes of the medium (such as zooming in on objects) create the conditions for learning. Thus, as in traditional classrooms, it is the quality of the instruction delivered via the medium which is important. Evaluation of student learning outcomes as a result of participating in courses transmitted from the University will be conducted and made available to school systems. Further evaluations of student and teacher attitudes to the type and quality of instruction occurring and teacher satisfaction with their involvement in collaborative planning for interactive television courses are also necessary. It is hoped that teachers who observe instructors via interactive television will transfer some of the teaching strategies modeled to their own classrooms. Assessment of the type and frequency of instructional strategies used in participating schools will occur.

Once inter-system transmissions are underway we shall have the opportunity to assess the preparedness and effectiveness of teachers who teach via interactive television. It is our contention that interactive television will require teachers to improve the quality of lesson planning and increase the variety of teaching strategies employed. Inservice courses will thus be made available via the Network and will be directed toward

fostering such changes in teaching behavior. Guskey [16] reports that promoting successful change in teaching practices requires that the teacher see improvement in student learning outcomes. Thus formative and summative evaluation of student attitudes to learning, and their achievement will be provided for teachers who conduct courses via interactive television. As teachers continue to see gains in student learning outcomes the changes they have made in their teaching practices will be reinforced.

School year 1987/88 will find us being more selective in the courses transmitted from the University. We have found that high school teachers wish to expose their students to learning opportunities which are not normally available to them (the demonstration lesson from the nuclear reactor being one such example). Thus further activities of this nature are planned. Such liaisons between the University and schools will also afford students the occasion to experience some of the opportunities available at the University of Lowell and may influence them to apply to study at the institution. High schools have also requested that university level courses in mathematics and science be offered, although the demand is small. We perceive the need to offer graduate level courses in various content areas to teachers who may not be conversant with new work in their field and/or need their basic understanding of the subject refreshed. At present such teachers are loathe to travel to the university for instruction, but if such courses were to be received in their own school building then they might be encouraged to attend.

Elementary schools will continue to receive activity-based science instruction, as well as offerings in other subject domains. It is hoped that these opportunities can be expanded to the middle grades.In addition inservice courses directed at improving instructional strategies in the classroom will also be offered.

Conclusion

Our work with the Instructional Telecommunications Network has engaged us in an exploration of its capabilities. Through the use of expert instructors we were able to concentrate on the modifications demanded by the medium which enable the translation of proven successful classroom teaching strategies to interactive television lessons. Watching the planning in which these instructors engage and the techniques developed as they adapt to a very different classroom environment, has allowed us to develop guidelines to help high school and elementary teachers as they embark upon their first interactive television teaching experiences.

From the first we have seen a role for interactive television in the improvement of instruction. Working with teachers as they plan their lessons, suggesting strategies or uses of the medium

which will enhance their presentations, and encouraging them to involve students at both sites, are all aspects of our training program which may also impact the way in which these teachers approach their traditional classroom work. Similarly the opportunity for classroom teachers to observe expert instructors using a variety of techniques to achieve their goals may have ramifications for their own teaching. Thus the primary reason for the existence of the Instructional Telecommunications Network at the University of Lowell is not to provide advanced courses for a small number of students, but to influence what happens in classrooms throughout the region.

If future evaluation of the effectiveness of teachers who use interactive television, or of those who have observed lessons taught via the medium, fails to show any significant change in the strategies employed and/or the achievement of students, we shall reconsider its value in this area. Nevertheless we have already demonstrated that interactive television is providing students and teachers with educational opportunities not previously open to them and has created a forum for the professional exchange of ideas. Therefore it is clear that the technology now does not merely sustain normal practices, but what we also hope to see in the future is an improvement in student learning outcomes.

FOOTNOTES

* There are many examples of interactive telecommunications networks in existence employing one-way video and two-way audio or data transmission. The networks here described are full motion, two-way video and audio.

** The aspect ratio for television is 3 units high and 4 units wide.

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